Family list
1 family member for: **CA1224657**
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1. **WET-PRESSING BELT FOR PAPER-MACHINES**

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(54) Wet-Pressing Belt for Paper-Machines

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A B S T R A C T

A belt to be used in paper-machine wet-pressing, in particular in a machine with an extended pressing gap, includes a flexible, liquid-impermeable belt layer which is smooth on its back side. The front side of the belt has a structured surface with open longitudinal and/or transverse channels for the purpose of water drainage, which under press compression are substantially non-compressible.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A paper machine dehydration belt, comprising:

(a) a liquid impermeable belt stratum;

(b) a plurality of consecutively arrayed water drainage channels disposed along a first face of said stratum for draining water away therefrom;

(c) each of said channels defined by a plurality of adjacently disposed filamentary loops and each of said loops having a portion thereof disposed in said stratum and a portion extending beyond said first face;

(d) each of said loops comprised generally of substantially straight first and second legs and end portions connecting the legs; and,

(e) each loop of a channel having an end portion disposed between and pivotally connected by means with the end portions of the adjacent loops of the adjacent channels so that the loops of said channels are successively disposed with clockwise and counterclockwise pitches.

2. The belt as defined in claim 1, wherein:

(a) the end portions of the loops of adjacent channels overlap and define openings; and,

(b) coupling filaments pass through said openings and thereby pivotally interconnect the loops of adjacent channels.

3. The belt as defined in claim 1, wherein:

(a) a plurality of filaments being disposed within said stratum and being aligned with said channels and overlying the por-

tion embedded in said stratum for improving the strength of said belt.

4. The belt as defined in claim 1, wherein:

(a) said channels extending in the longitudinal direction of said stratum.

5. The belt as defined in claim 1, wherein:

(a) said channels extending transverse to the longitudinal direction of said stratum.

6. The belt as defined in claim 1, wherein:

(a) said stratum having first and second end portions; and,

(b) means interconnecting said end portions for thereby providing a continuous belt.

7. The belt as defined in claim 6, wherein:

(a) said interconnecting means including first and second lap strips, each of said lap strips associated with one of said end portions; and,

(b) said lap strips being secured together.

8. The belt as defined in claim 7, wherein:

(a) a cross-boss being associated with said first lap strip; and,

(b) a cross-groove being associated with said second lap strip and being adapted for receiving said cross-boss for thereby securing said lap strips together.

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9. The belt as defined in claim 7, wherein:

(a) adhesive means being associated with one of said lap strips for securing said lap strips together.

10. The belt as defined in claim 7, wherein:

(a) said first lap strip having a beveled portion; and,

(b) said second lap strip having a beveled portion cooperating with said first lap strip beveled portion so that said beveled portions rest against each other and thereby provide a liquid impermeable seal when said lap strips are secured together.

11. A dehydration belt for extended pressing gaps of paper machines, comprising:

(a) a liquid impermeable belt stratum;

(b) a plurality of individual filamentary loops, each of said loops having first and second substantially straight leg portions and arcuate end portions associated therewith for connecting the legs of a loop;

(c) said loops disposed in a plurality of generally aligned consecutively disposed rows and with the first leg of each loop embedded in said stratum and with the second leg thereof disposed above said stratum so that said second legs and said end portions cooperate with the outer face of said stratum for providing a plurality of drainage channels;

(d) the loops of each row disposed in spaced parallel relation;

(e) the loops of each row being angularly disposed relative to the loops of the immediately precedent and subsequent rows so that the loops of said channels have an alternating clock-

wise and counterclockwise orientation;

(f) the end portions of the loops of each row overlap and provide a plurality of openings; and,

(g) means extend through said openings and pivotally interconnect said loops of each of said rows.

12. The belt as defined in claim 11, wherein:

(a) said connecting means including a plurality of filaments.

13. The belt as defined in claim 11, wherein:

(a) a plurality of filaments being embedded in said stratum and overlying said first legs; and,

(b) said filaments being longitudinally aligned with said rows for strengthening said belt.

14. The belt as defined in claim 11, wherein:

(a) said stratum having first and second end portions; and,

(b) means securing said end portions together for thereby providing a continuous belt.

15. The belt as defined in claim 14, wherein:

(a) each of said end portions including a lap strip and said lap strips being secured together.

16. The belt as defined in claim 15, wherein:

(a) a cross-groove extending along one of said lap strips; and,

(b) a cross-boss extending along the other lap strip and

being positionable in said cross-groove for thereby securing said strips together.

17. The belt as defined in claim 15, wherein:

(a) adhesive means securing said lap strips together.

18. The belt as defined in claim 15, wherein:

(a) each of said lap strips having a beveled portion; and,

(b) said beveled portions conforming when said lap strips are secured together for thereby providing a liquid impermeable seam.

19. The belt as defined in claim 11, wherein:

(a) said channels extending longitudinally of said stratum.

20. The belt as defined in claim 11, wherein:

(a) said channels extending transverse to the longitudinal direction of said stratum.

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The invention concerns a belt to be used in paper-machine wet-pressing, in particular with an extended pressing gap, and provided with a smooth, liquid-impermeable layer on its back side.

A substantial part of the liquid still present in paper webs is forced out of the wet-presses of paper machines. Compression rollers are used which jointly form a pressing gap through which the web and a revolving felt cloth pass. Due to the pressure in the pressing gap, the liquid is forced out of the web and into the felt cloth from which it is then drained.

Recently wet-presses with an extended gap, the so-called nip-presses have been developed, wherein the web is moved over a longer path, is accordingly exposed for a correspondingly longer time to high press squeezing, and hence leaves the wet press in a drier state. Such wet presses have been disclosed for instance in the German Auslegeschriften 23 38 414 and 24 13 280, in United States patents 3,808,092 and 3,970,515, in German Auslegeschrift 29 35 630 and German Offenlegungsschrift 29 35 630. Two basically different designs have been developed.

In one design the webs and one or two felt cloths are made to pass between two liquid-impermeable belts in the pressing gap. This pressing gap consists of two compression chambers resting against the back sides of the belts and hydraulically actuated, whereby they compress from both sides the belts and the webs and felt cloths passing between them.

In the other design the web is guided over a section of one or more compression rollers with pressure being applied across this section in the direction of the compression roller. This is

implemented in this case also by means of a hydraulically actuated compression chamber acting on a flexible, liquid-impermeable belt revolving jointly with the web and the felt cloth.

The belts used for the above purposes are flexible plastic belts smooth on both sides, the plastic being required to be resistant to the liquid used in the compression chambers and to have high abrasion resistance. These belts cannot absorb the water forced out of the web and therefore all of the water from the felt cloth(s) must be drained. Because of the high compression and the comparatively long path over which this compression is applied, the amount of water is larger than when wet-pressing without the extended pressing gap.

It is the object of the invention to improve dewatering in paper-machines wet-presses using the belts cited initially, in particular in wet-pressing with extended pressing-gaps.

The invention provides a paper machine dehydration belt, comprising:

(a) a liquid impermeable belt stratum;

(b) a plurality of consecutively arrayed water drainage channels disposed along a first face of said stratum for draining water away therefrom;

(c) each of said channels defined by a plurality of adjacently disposed filamentary loops and each of said loops having a portion thereof disposed in said stratum and a portion extending beyond said first face;

(d) each of said loops comprised generally of substantially straight first and second legs and end portions connecting the legs; and,

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(e) each loop of a channel having an end portion disposed between and pivotally connected by means with the end portions of the adjacent loops of the adjacent channels so that the loops of said channels are successively disposed with clockwise and counterclockwise pitches.

The invention also provides a dehydration belt for extended pressing gaps of paper machines, comprising:

(a) a liquid impermeable belt stratum;

(b) a plurality of individual filamentary loops, each of said loops having first and second substantially straight leg portions and arcuate end portions associated therewith for connecting the legs of a loop;

(c) said loops disposed in a plurality of generally aligned consecutively disposed rows and with the first leg of each loop embedded in said stratum and with the second leg thereof disposed above said stratum so that said second legs and said end portions cooperate with the outer face of said stratum for providing a plurality of drainage channels;

(d) the loops of each row disposed in spaced parallel relation;

(e) the loops of each row being angularly disposed relative to the loops of the immediately precedent and subsequent rows so that the loops of said channels have an alternating clockwise and counterclockwise orientation;

(f) the end portions of the loops of each row overlap and provide a plurality of openings; and,

(g) means extend through said openings and pivotally interconnect said loops of each of said rows.

This solution is based on the concept of providing a dual function to the belt, namely on one hand to assume the pressure transmission to the web and on the other hand to assume the drainage of the water forced out of the web. It was found that de-watering can be substantially improved by such structuring of the front side of the belt layer, which entails only minor additional costs. The term "front side" denotes that side of

the belt that faces the web, i.e. the felt cloth(s), while the back side is loaded by the compressing medium.

In one embodiment of the invention, the structured surface consists of a plurality of mutually engaging filamentary loops with alternating clockwise and counter-clockwise pitches and partly embedded into the belt layer. Such structures formed by filamentary loops are known from the German Offenlegungsschrift 24 19 751 as belts of filament segments. They are characterized in the present combination by forming longitudinal or transverse channels depending on their direction, where these channels are open towards the top and thereby provide good water drainage. They are dimensionally stable to the extent that at the prevailing wet-pressing compression loading using extended pressing gaps, they will not be squeezed together, and therefore the channels always stay open.

Where the filament loops consist of two substantially straight loop-legs and of end-arcs connecting these, the surface formed by the filament loops is sufficiently plain that markings are avoided and felt-abrasion is reduced to a minimum.

To improve the dimensional stability of the structured surface consisting of the filament loops, the latter preferably are mutually connected by coupling filaments in the areas of overlap. Additionally multifilaments and/or single filaments can be inserted into the filament loops and appropriately embedded in the belt layer. These increase the dimensional stability of the belt in the direction of their orientation and also improve the adhesion of the filament loops to the belt layer.

Alternatively to the use of the filament loops, the struc-

tured surface also can be obtained using a fabric with at least a double ply and of which the weave forms the longitudinal and/or transverse channels, the fabric being partly embedded in the belt layer. Especially compression-proof strainer fabrics such as are used in the wet end of paper machines are applicable for this purpose.

To make it possible to form the longitudinal and/or transverse channels, the yarns extending in one direction of the fabric can be made substantially thicker than those extending in the other. To keep the channels open, the number of yarns in the fabric's outer ply should be substantially fewer than those in the inner ply.

In an especially preferred embodiment, the belt of the invention is open-ended and provided with lap strips which can be joined in the paper machine. This substantially simplifies belt installation in the paper machine. The lap strips should overlap longitudinally so that the pressure on the belt exerted by the compression chambers in the area of overlap be applied in sealing manner. Additionally one of the lap strips can be provided on that side facing the other lap strip with a cross-sectional contour, for instance a transverse square groove engaged by a particular matching shape, for instance a transverse rib on the other lap strip. A positively locking lap closure is achieved in this manner. The thickness of the lap strip should be such that in the superposed condition it will be the same thickness as the belt layer. Moreover at least one of lap strips may be equipped with a sealing or adhesive substance on the side facing the other lap strip. Again, the leading edge of at least one of the lap strips should be

bevelled and rest on the inside against a corresponding bevel of the particular other lap strip.

Where the structured surface of the belt of the invention is formed by the transverse filament loops, those abutting the lap can be joined together in simple manner so their structure in the area of the lap will remain constant. The junction can be additionally stabilized in this case by coupling filaments. In the case the structured surface is formed by a fabric or longitudinal filament loops, a fine special seam is provided making it possible to seal the fabric or filament loops additionally to the belt layer, so that a continuously structured surface is achieved in this region.

The invention will further be described, by way of example only, with reference to the accompanying drawings, wherein:-

Figure 1 is a cross-section of a wet-pressing belt of a paper machine;

Figure 2 is a partial top view of the belt of Figure 1;

Figure 3 is a longitudinal section of the ends of another belt for the wet press of a paper machine;

Figure 4 shows the belt of Figure 3 in an intermediate position before coupling of the belt ends;

Figure 5 is similar to Figures 3 and 4 and shows the coupled position of the belt ends;

Figure 6 is a cross-section of another belt for the wet press of a paper machine; and

Figure 7 is a cross-section of another belt for the wet press of a paper machine.

The belt shown in Figure 1 is a cross-section transverse

to the direction of advance while Figure 2 shows a partial top view. The belt 1 consists of a belt layer 2 with a filament structure 3 embedded therein, for instance by its lower part being moulded into the front side of belt 1.

The filament structure 3 consists of a plurality of individual filament loops 4 spaced in the direction of advance of the belt 1 and parallel to each other, being flattened in such a manner that semi-circular end-arcs 6 join the straight loop legs 5. The straight loop legs 5 provide an open yet relatively flat surface preventing markings and felt abrasion.

The end-arcs 6 of the individual filament loops 4 overlap in such a manner as to permit passing through them coupling filaments 7 to form a positive connection between the single filament loops 4. Longitudinal filaments 8 passing between the loop legs 5 and embedded in the belt layer 2 are also provided to improve the strength of the belt 1 in the longitudinal direction.

As shown in particular by Figure 1, longitudinal channels 9 are formed by the filament loops 4 to provide water drainage when the belt 1 is used in wet-pressing, especially with an extended pressing gap. In that application the pressure is most often exerted by a hydraulically actuated compression chamber on the smooth back side of the belt 1. This pressure is transmitted by the filament loops 4 to a felt cloth and a paper web (not shown). This web rests either directly or through another felt cloth on a roll. The compression forces out the water in the felt cloth and the water can be drained through the longitudinal channels 9 formed by the filament loops 4. In the present embodiment this is carried out in the longitudinal direction. The dimensional stability of

the filament loops 4 is such that they will not be forced together under the compression.

Figure 2 shows that the longitudinal channels 9 are open upwards on account of the spacing between the individual loop-legs 5, and that the water from the felt cloth can without significant impediment enter into the longitudinal channels 9 and drain from there.

Figures 3 to 5 show another embodiment of the belt 10 of the invention represented as a section in the direction of advance of this belt 10, namely near the lap. This belt 10 differs from belt 1 shown in Figures 1 and 2 merely in that the filament structure 11 -- which otherwise is identical in all respects -- is here rotated by 90° and embedded in the belt layer 12, whereby the filament loops 13 of the filament structure 11 form cross-channels 14 extending in the transverse direction. The water pressed out of the web and the felt cloth in this instance therefore is drained toward the sides of the belt 10.

In this embodiment the ends of the belt 10 can be coupled in an especially simple manner. For that purpose, the belt 10 is provided at both ends with lap strips 15,16. The lap strip 15 of the end of belt 10 shown to the left in Figure 3 is recessed at its top side 17 to such an extent that the filament structure 11 is free. The lower side is also recessed, and in such a manner that a cross-rib 18 is formed which extends over the entire width of the lap strip 15 and projects downwards. The lap strip 15 is provided with a bevel 19 facing the belt 10.

The lap strip 16, which in Figure 3 is at the right end of the belt 10, is recessed only on its top side. There it has

a cross-groove 20 matching the cross-rib 18 of the other lap strip 15. The lap strip 16 has a bevel 21 toward the free edge, this bevel 21 corresponding to the bevel 19.

Figure 3 shows the lap strips 15,16 when they are still apart. Above the lap strips 15,16, there is a bridging filament structure 22 consisting of three filament loops 13. This bridging filament structure 22 is connected by coupling filaments 23 to the filament structure 11 embedded in the ends of the belt layer 12, whereby the structure 11 is now closed. As shown in Figure 4, the lap strips 15,16 are then moved together and placed on each other, so that the cross-rib 18 enters the cross-groove 20 and the bevels 19,20 abut. In operation these faces are forced on each other by the press compression and a liquid-impermeable connection is thus automatically obtained. It is possible to further enhance the tightness of this connection by depositing an adhesive on at least one of the opposite sides of the lap strips 15,16. Because the thicknesses of the lap strips 15,16 are adjusted so that the overall thickness in the assembled state is constant, uniformity is preserved.

Figure 6 shows another embodiment of the invention. The belt 24 consists of a belt layer 25 and of a compression-proof filament structure 26 embedded by its lower part in the layer 25. The structure 26 is made of two plies. The lower ply 27 is located within the belt layer 25 and the upper ply 28 is spaced from front-side surface of the belt layer 25. Both plies 27,28 are formed by relatively thick warp yarns 29 extending in the direction of advance of the belt 24, the number of the warp yarns 29 in the lower ply 27 being double that of the warp yarns in the upper ply

28. Therefore there is only one warp yarn 29 in the upper ply 28 over every second warp yarn 29 in the lower ply 27, whereby the fabric 26 is open upwards and broad longitudinal channels 30 are formed between the warp yarns 29.

The warp yarns 29 of the lower ply are bound by filling yarns 31 which extend solely within the belt layer 25. The binding is performed in such a manner the filling yarns 31 pass alternatingly on the upper side of one warp yarn and on the lower side of the next warp yarn, etc.

The above-mentioned system of filling yarns alternates with filling yarns 32,33,34 providing the connection between the lower ply 27 and the upper ply 28 of the fabric 26. These filling yarns 32,33,34 are so arranged that they each bind every sixth warp yarn 29 of the lower ply 27 and every third warp yarn 29 of the upper ply 28, being offset each time by one warp yarn in the upper ply 28 in the direction of the filling yarns in the manner of a satin weave. A fabric 26 so built is practically never squeezed together under press compression, and accordingly the longitudinal channels 30 remain open to drain the water.

Figure 7 shows a belt 35 into the layer 36 of which is embedded the lower part of a filament structure 37 of a different design. This structure 37 is also made of two plies, the lower ply 38 being within the belt layer 36 and the upper ply 39 being spaced from the surface of this layer 36. As in the embodiment of Figure 6, the two plies 38,39 are formed by relatively thick warp yarns 40 extending in the direction of advance of the belt 35, the number of warp yarns 40 in the lower ply 38 being twice that in the upper ply 39. However the warp yarns 40 in the upper ply 39 are offset

in such a manner that they are located above the gap between two warp yarns 40 in the lower ply 38. The warp yarns 40 of the upper ply 39 form broad longitudinal channels 41 to drain water from the web and the felt cloth.

A separate system of filling yarns with filling yarns 42,43 is provided to tie the warp yarns 40 in the lower ply 38, where they extend within the belt layer 36. The yarns 42,43 each bind two adjacent warp yarns 40 to one side before changing sides. Furthermore these yarns 42,43 are always mutually offset by two warp yarns 40 as seen in the direction of the filling yarns.

The connection between the lower ply 38 and the upper ply 39 is implemented by further filling yarns 44,45. Each of these filling yarns 44,45 first ties one warp yarn 40 in the upper ply 39 and then two warp yarns 40 in the lower ply 38 before returning upward. Also the filling yarns 44,45 are mutually offset in the direction of the filling yarns in this case as well, namely each time by one warp yarn 40 of the upper ply 39.

This fabric 37 is also compression-proof, so that the longitudinal channels 41 are also kept intact in the pressing gap. Therefore water drainage is assured in this critical region.

Applicable materials for the belt layers 2,12,25,36 predominantly are elastic, but also thermosetting or thermoplastic polymers, the polymer being determined by the particular application. Typical examples are polyurethane, butadiene-styrene resins, epoxy resins, chlorinated rubber, PVC, polyacrylates, among the commercial polymers. The filament structures 3,11 can be made of synthetic polymers such as polyesters or polyamides.

Fig. 1

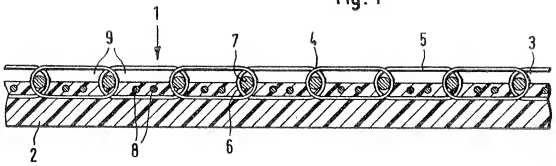

Fig. 2

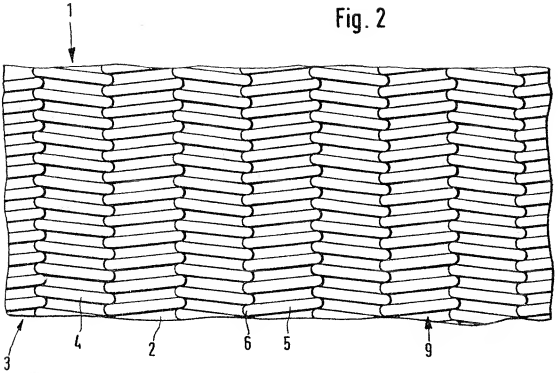

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Fig. 3

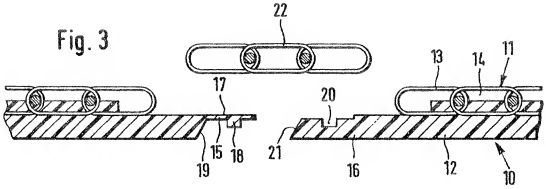


Fig. 4

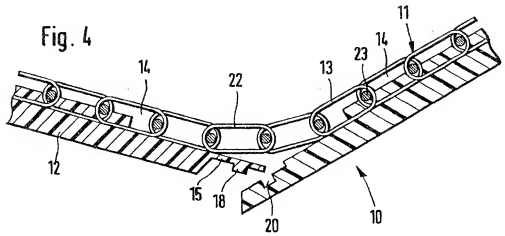
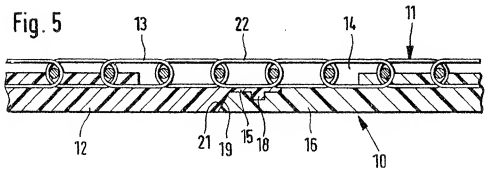


Fig. 5



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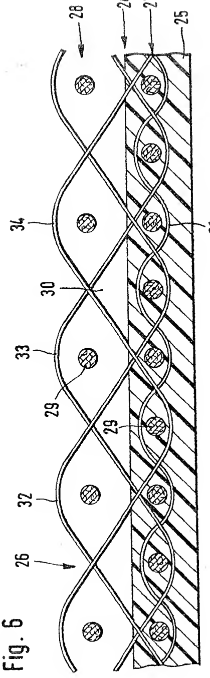

Fig. 6

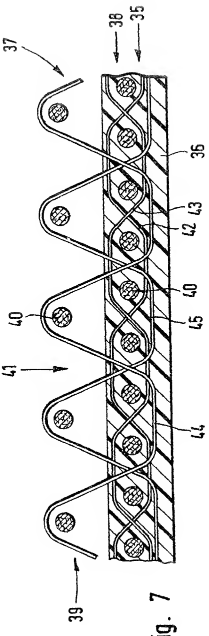

Fig. 7